

Institute of Paper Science and Technology
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CONTINUOUS EVALUATION OF CORRUGATING MEDIUM

Project 1108-17

Progress Report 47

to

FOURDRINIER KRAFT BOARD INSTITUTE, INC.

August 1, 1959

THE INSTITUTE OF PAPER CHEMISTRY

Appleton, Wisconsin

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THE INSTITUTE OF PAPER CHEMISTRY

Appleton, Wisconsin

CONTINUOUS EVALUATION OF CORRUGATING MEDIUM

PURPOSE OF THIS STUDY

The purpose of this study is to provide a continuous evaluation of the quality and runability of corrugating medium produced by members of the Fourdrinier Kraft Board Institute. The study, as it progresses, is accumulating a backlog of data and experience which provides two important benefits. First, it enables each participant to evaluate his position in relation to the rest of the industry. Second, it provides background information essential for the judicious interpretation of any proposed specifications on corrugating medium (on either a company or industry basis).

PROCEDURE FOR PARTICIPATING

The procedure for participating in this study involves the submission of two rolls of corrugating medium per week from each machine to The Institute of Paper Chemistry. These rolls are taken from regular production runs on different days. Each roll is 10 to 12 inches wide and contains approximately 5,000 lineal feet of medium (approximately 30 inches in diameter). When received by the Institute, each roll is assigned a code letter and number. The rolls are numbered in the sequence in which they are received. Code letters are assigned on the basis of machines, and a given machine is assigned a different code letter each month in order to mask the identity of the mills. For purposes of reference, an outline of this program which describes the necessary instructions for sampling was appended to Progress Report One in this series.

PRESENTATION AND DISCUSSION OF TEST RESULTS OBTAINED AT
THE INSTITUTE OF PAPER CHEMISTRY

During the month of July, ninety-four sample lots of corrugating medium were selected from the production of fifteen machines and submitted to The Institute of Paper Chemistry for evaluation. A tabulation of the number of rolls submitted from each machine is given in Table I.

Each sample of corrugating medium was evaluated for basis weight, caliper, Concora flat crush (conditioned after fluting, Concora flat crush (tested immediately after fluting), H. and D. flat crush (single-faced board), and runability. Concora flat crush results obtained on specimens tested immediately after fluting were included for the first time in Progress Report 45. Runability was measured by corrugating each roll under standardized conditions on the Institute's corrugator into A-flute board at 600 feet per minute with minimum tension. If unsatisfactory runability occurred at this speed, the corrugator was slowed down in increments of 25 f.p.m. until satisfactory runability was obtained (no ruptured flutes). If the medium fabricated satisfactorily at 600 f.p.m. with minimum tension, further runs were made at higher tensions to determine when cracking occurred. The higher tensions used were 0.5 lb. per inch, 1.0 lb. per inch, and 1.5 lb. per inch.

Flat crush was determined on the board obtained at a speed of 600 f.p.m. with minimum tension. In addition to information about quality, these results will provide data which may be useful in studying the relationship between Concora flat crush and combined board flat crush for each participant's medium.

TABLE I

NUMBER OF ROLLS OF CORRUGATING MEDIUM SUBMITTED
FOR EVALUATION FROM EACH MACHINE

Machine Code	Number of Rolls
A	8
B	8
C	6
D	4
E	8
F	7
G	8
H	7
I	2
J	6
K	6
L	8
M	8
N	1
O	<u>7</u>
Total	94

As requested by members of the F.K.B.I., the Concora medium test results are calculated on the basis of pounds of load per unit area rather than on the basis of the formula suggested by the Concora manufacturer and are reported as Concora flat crush test results. In Progress Reports One and Two, the Concora medium test results were reported on the basis of the formula suggested by the Concora manufacturer.

The average test results obtained on the rolls of corrugating medium submitted by each participant (current machine averages) are shown in Table II and graphically presented in Figures 1 to 5. In addition to a comparison of the test data obtained for the various machines, Table II also presents the current F.K.I. averages, cumulative F.K.I. averages, and the F.K.I. indexes. The current F.K.I. average is the average of test results for all machines participating in the study during the current month. The cumulative F.K.I. average is based on the results for the previous twelve-month period excluding the result for the current period. The F.K.I. index is obtained as follows:

$$\frac{\text{current F.K.I. average}}{\text{cumulative F.K.I. average}} \times 100 = \text{F.K.I. index (\%)}$$

The F.K.I. index provides a ready means of comparing the current quality with previous results. An index greater than 100% indicates that current quality is higher than the average result for the previous twelve periods; an index below 100% indicates that current quality is lower than the average result for the previous twelve periods.

TABLE II
SUMMARY OF CURRENT MACHINE AVERAGES
July, 1959

Mill Code	Basis Weight, lb.	Concora Flat Crush, p.s.i. (Conditioned)	Concora Flat Crush, p.s.i. (Tested Immediately)	Single-Face Flat Crush, p.s.i.
A	26.8	9.8	46.5	35.5
B	26.4	9.8	46.6	34.5
C	27.2	9.9	49.7	36.6
D	27.4	11.0	46.1	32.6
E	27.0	10.6	54.0	38.4
F	27.6	10.2	49.7	37.5
G	27.0	10.7	44.8	32.5
H	26.9	10.0	50.0	36.8
I	26.6	10.4	42.8	29.9
J	26.7	9.5	45.6	34.2
K	26.4	9.5	44.2	34.3
L	26.8	9.4	47.3	34.7
M	26.6	10.7	41.9	32.5
N	27.1	10.7	55.0	39.0
O	29.0	10.6	45.7	33.3
Current F.K.I. Average	27.0	10.2	47.3	34.8
Cumulative F.K.I. Average	27.2	10.2	46.9	32.7
F.K.I. Index, %	99.5	100.0	101.0	106.4

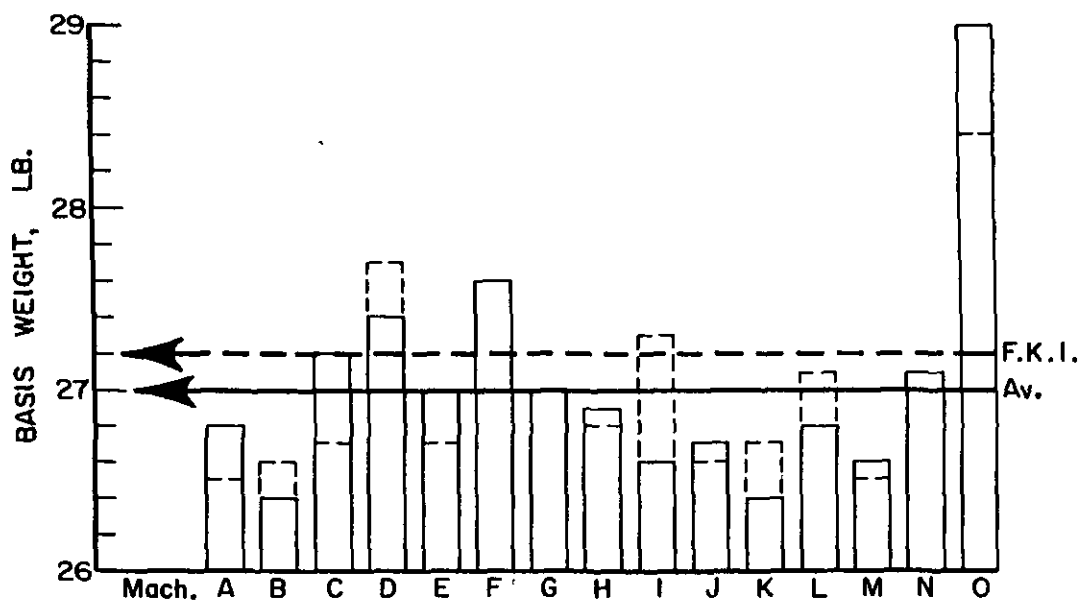


Figure 1

Comparison of Basis Weight Results for July, 1959

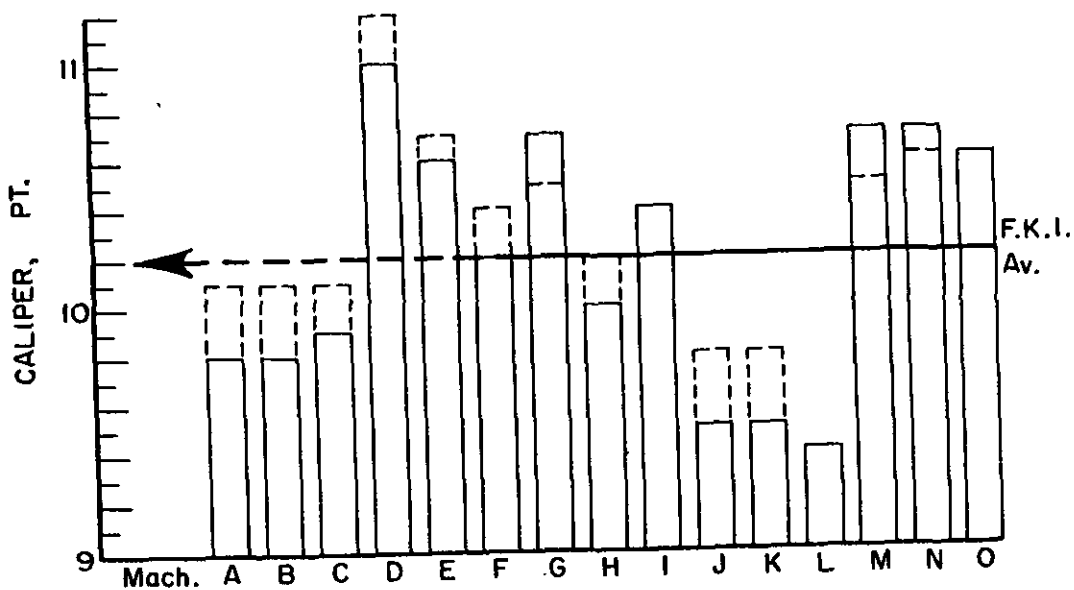


Figure 2

Comparison of Caliper Results for July, 1959

—— Current machine average
----- Cumulative machine average

In Table II the current machine averages for the month of July are summarized. It may be noted in Table II and Figure 1 that basis weight varied from a low of 26.4 lb. for Machines B and K to a high of 29.0 lb. for Machine Q. The current F.K.I. average for basis weight was 27.0 lb. which was slightly lower than the cumulative F.K.I. average of 27.2 lb. None of the current machine averages shown in Table II were below the 26-lb. minimum requirement of Rule 41. On the basis of individual rolls, it may be noted that the tabulated data for each machine shown in Tables III through XXI included eight basis weight averages which were below 26 lb.

With regard to the caliper results for the current period, it may be seen in Table II and also in Figure 2 that the lowest average caliper data of 9.4 points was associated with Machine L and the highest average of 11.0 points with Machine D. The current F.K.I. average of 10.2 points was the same as the cumulative F.K.I. average. The minimum caliper requirement of nine points specified in Rule 41 was met by all participants on the basis of the current machine averages shown in Table II. Based on individual rolls, only one average was below nine points.

The Concora flat crush averages obtained on specimens conditioned after fluting are presented graphically in Figure 3 and in tabular form in Table II. An inspection of these results reveals that 44.4 p.s.i. was the highest average and 31.7 p.s.i. the lowest. Machine N had the highest average and Machine I the lowest. The current F.K.I. average of 38.0 p.s.i. was higher than the cumulative F.K.I. average of 36.4 p.s.i.

The Concora flat crush averages obtained on specimens tested immediately after fluting are shown graphically in Figure 4 and were obtained from Table II. Machine N had the highest average of 55.0 p.s.i. and Machine M the lowest average of 41.9 p.s.i. The current F.K.I. average was 47.3 p.s.i. which was slightly higher than the cumulative F.K.I. average of 46.9 p.s.i.

The highest single-face flat crush average of 39.0 p.s.i. was obtained for Machine N and the lowest of 29.9 p.s.i. for Machine I. These data are shown in Table II and presented graphically in Figure 5. The current F.K.I. average was 34.8 p.s.i., whereas the cumulative F.K.I. average was 32.7 p.s.i.

For the current period, the current F.K.I. average for basis weight was lower than the cumulative F.K.I. average, the current F.K.I. average for caliper was the same as the cumulative F.K.I. average, the current F.K.I. averages for Concora flat crush (conditioned), Concora flat crush (tested immediately), and single-face flat crush were higher than their respective cumulative F.K.I. averages.

The test results obtained on the sample lots submitted from the production of each of the machines are shown in Tables III through XVI for Machines A through O, respectively. The maximum, minimum, and average test results obtained on each sample lot are shown for all tests except basis weight for which only the average is shown; in addition, the over-all average result for all sample lots submitted from a given machine is shown for each test. The latter over-all averages are reported as "current machine averages." A cumulative machine average is also shown and is calculated by averaging

the current machine averages for the previous twelve periods (excluding the current period). Also shown for each machine in Tables III to XVI are the machine factor and machine index which are defined as follows:

$$\frac{\text{current machine average}}{\text{cumulative machine average}} \times 100 = \text{machine factor (\%)}$$

$$\frac{\text{current machine average}}{\text{cumulative F.K.I. average}} \times 100 = \text{machine index (\%)}$$

The machine factor and machine index provide a means for comparing the current machine average with either the previous results for that particular machine or with the cumulative results for all machines--i.e., the cumulative F.K.I. average.

TABLE III
SUMMARY OF TEST RESULTS FOR MACHINE A
July, 1959

Code	Date Made	Date Recd.	Roll No.	Basis Weight, lb. per 1000 sq. ft.	Caliper, points		Concora Flat Crush, p.s.i. (Conditioned)			Concora Flat Crush, p.s.i. (Tested Immediately)			Single-Face Flat Crush, p.s.i.		Runability Maximum Tension at 600 f.p.m., lb./in.					
					Max.	Min.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.		Av.				
A-1	6-23-59	7-1-59	97	27.5	10.7	9.1	10.0	46.3	39.6	42.5	49.2	42.0	45.5	37.8	35.0	36.4	1/2			
A-2	6-30-59	7-1-59	87	26.9	9.8	9.1	9.4	45.0	39.0	41.6	50.4	45.6	47.6	37.6	36.0	36.6	1-1/2			
A-3	6-30-59	7-2-59	75	27.3	10.0	9.3	9.8	42.6	37.2	40.7	49.8	46.2	48.6	37.8	34.6	36.0	1-1/2			
A-4	7-7-59	7-16-59	1307	26.7	10.0	9.3	9.8	35.4	33.6	34.3	46.2	40.2	43.4	35.0	31.4	33.5	1/2			
A-5	7-9-59	7-16-59	1307	26.5	10.3	9.9	10.1	39.0	35.4	37.3	49.2	45.0	47.0	36.6	35.4	36.0	Note a			
A-6	7-14-59	7-16-59	3A	27.0	10.5	9.3	10.1	36.6	32.4	35.5	49.2	43.8	46.0	38.0	33.6	36.0	Min.			
A-7	7-15-59	7-16-59	1	26.5	10.3	9.8	10.0	37.2	34.2	36.0	48.0	43.2	46.2	36.0	34.0	34.9	Min.			
A-8	7-16-59	7-20-59	3B	25.8	9.8	9.2	9.5	40.2	37.2	38.9	52.2	43.2	47.9	36.4	31.4	34.1	Min.			
Current Machine Average				26.8	9.8		38.4		46.5		35.5		33.7		105.3					
Cumulative Machine Average				26.5	10.1		36.3		44.6		105.3		108.3							
Machine Factor, %				101.1	97.5		105.6		104.4		99.2									
Machine Index, %				98.6	96.6		105.4													

a Maximum speed at minimum tension for this roll was 500 f.p.m.

TABLE IV
SUMMARY OF TEST RESULTS FOR MACHINE B
July, 1959

Code	Date Made	Date Recd.	Roll No.	Basis Weight, lb. per 1000 sq. ft.	Caliper, points		Concora Flat Crush, Concora Flat Crush, p.s.i. (Conditioned) p.s.i. (Tested Immediately)			Single-Face Flat Crush, p.s.i.		Runability Maximum Tension at 600 f.p.m., lb./in.
					Max.	Min.	Max.	Min.	Av.	Max.	Min.	
3-1	6-29-59	7-1-59	97	26.6	9.8	9.3	41.4	37.8	39.6	34.4	33.0	1-1/2
3-2	6-30-59	7-1-59	87	27.1	10.3	9.9	40.8	37.2	38.5	34.6	32.6	1-1/2
3-3	6-30-59	7-2-59	75	26.3	10.0	9.4	37.8	36.6	37.2	35.4	31.0	1-1/2
3-4	7-7-59	7-16-59	1307	25.8	9.9	9.3	36.0	33.0	34.6	37.6	34.6	1/2
3-5	7-9-59	7-16-59	1307	26.3	10.6	9.8	37.2	33.6	35.3	35.0	32.0	1/2
3-6	7-14-59	7-16-59	3A	25.9	10.0	9.4	37.2	36.0	36.8	36.4	32.8	min.
3-7	7-15-59	7-16-59	1	26.9	10.0	9.8	40.2	36.0	38.2	39.4	34.2	Min.
3-8	7-16-59	7-20-59	3B	26.4	9.6	9.2	41.4	37.8	39.4	37.6	36.2	min.
Current Machine Average				26.4	9.8		37.4			46.6		34.5
Cumulative Machine Average				26.6	10.1		36.7			45.8		33.2
Machine Factor, %				99.4	97.4		102.0			101.9		104.0
Machine Index, %				97.2	96.0		102.9			99.5		105.5

TABLE V
SUMMARY OF TEST RESULTS FOR MACHINE C
July, 1959

Code	Date Made	Date Recd.	Wall Roll No.	Basis Weight, lb. per 1000 sq. ft.	Caliper, points		Concora Flat Crush, p.s.i. (Conditioned)			Concora Flat Crush, p.s.i. (Tested Immediately)			Single-Face Flat Crush, p.s.i.		Runability Maximum Tension at 600 f.p.m., lb./in.
					Max.	Min.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	
C-1	6-29-59	7-1-59	97	27.7	10.3	9.6	43.2	40.8	41.9	54.6	41.4	50.4	40.4	36.6	1-1/2
C-2	6-30-59	7-1-59	87	27.8	10.1	9.7	49.2	41.4	43.9	55.8	49.8	53.3	41.4	37.0	1-1/2
C-3	6-30-59	7-2-59	75	27.7	10.3	9.8	49.2	37.8	42.0	53.4	45.0	50.0	38.0	36.0	1
C-4	7-14-59	7-16-59	3A	26.7	10.0	9.7	43.2	33.6	39.5	54.6	52.2	53.5	35.2	32.8	min.
C-5	7-15-59	7-16-59	1	26.7	10.2	9.9	40.2	36.6	38.5	50.4	45.0	47.5	38.6	34.6	min.
C-6	7-16-59	7-20-59	3B	26.6	10.0	9.6	37.8	33.6	35.8	47.4	40.8	43.6	37.0	33.2	1/2
Current Machine Average						9.9			40.3			49.7			36.6
Cumulative Machine Average						10.1			36.5			50.9			33.4
Machine Factor, %						97.8			110.2			97.7			109.7
Machine Index, %						97.2			110.6			106.0			111.8

TABLE VI
SUMMARY OF TEST RESULTS FOR MACHINE D
July, 1959

Code	Date Made	Date Recd.	Roll No.	Basis Weight, lb. per 1000 sq. ft.	Caliper, points			Concora Flat Crush, p.s.i. (Conditioned)			Concora Flat Crush, p.s.i. (Tested Immediately)			Single-Face Flat Crush, p.s.i.			Runability Maximum Tension at 500 f.p.m., lb./in.
					Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	
D-1	6-24-59	6-29-59	159	27.1	11.0	10.7	10.9	40.2	36.0	38.3	52.8	39.0	44.8	33.4	29.4	30.9	1-1/2
D-2	6-24-59	6-29-59	160	28.3	11.1	9.6	10.6	38.4	30.0	35.3	53.4	41.4	46.7	36.0	33.0	34.5	1-1/2
D-3	7-14-59	7-21-59	165	26.6	11.2	10.6	11.0	37.2	33.6	35.5	48.6	42.0	44.5	32.6	29.6	31.4	1/2
D-4	7-14-59	7-21-59	166	27.5	12.0	11.2	11.6	41.4	36.6	38.4	52.2	46.8	48.5	34.4	32.0	33.4	1/2
Current Machine Average				27.4			11.0			36.9			46.1			32.6	
Cumulative Machine Average				27.7			11.2			34.4			45.1			31.6	
Machine Factor, %				98.7			98.6			107.1			102.3			103.2	
Machine Index, %				100.8			108.3			101.3			98.3			99.4	

TABLE VII
SUMMARY OF TEST RESULTS FOR MACHINE E
July, 1959

Code	Date Made	Date Recd.	Wall Roll No.	Basis Weight, lb. per 1000 sq. ft.	Caliper, points		Concora Flat Crush, p.s.i. (Conditioned)		Concora Flat Crush, p.s.i. (Tested Immediately)		Single-Face Flat Crush, p.s.i.		Runability Maximum Tension at 500 f.p.m., lb./in.
					Max.	Min.	Max.	Min.	Max.	Min.	Max.	Avg.	
E-1	6-24-59	6-29-59	481	26.5	11.1	10.2	43.2	39.0	51.0	46.8	37.0	36.0	1-1/2
E-2	6-26-59	7-2-59	482	26.2	11.1	10.2	45.6	40.2	54.6	50.4	37.0	Note a	1-1/2
E-3	7-1-59	7-7-59	483	27.0	11.2	10.0	43.2	39.0	58.8	52.8	40.0	37.6	1-1/2
E-4	7-7-59	7-13-59	484	27.0	11.2	9.9	43.8	40.2	58.2	48.0	42.2	37.6	1-1/2
E-5	7-10-59	7-15-59	485	26.6	11.1	9.9	45.6	37.8	60.0	47.4	40.6	37.2	1-1/2
E-6	7-15-59	7-20-59	486	27.0	11.4	10.2	45.0	38.4	57.6	52.8	41.2	37.2	1-1/2
E-7	7-17-59	7-21-59	487	27.7	10.9	10.1	42.6	40.8	58.8	52.2	40.6	37.4	1-1/2
E-8	7-20-59	7-24-59	488	27.8	11.7	10.4	46.8	39.6	58.8	54.0	39.0	36.2	1-1/2
Current Machine Average				27.0	10.6		42.1		54.0		38.4		
Cumulative Machine Average				26.7	10.7		40.3		52.0		36.5		
Machine Factor, %				100.9	98.7		104.4		103.9		105.2		
Machine Index, %				99.3	103.7		115.7		115.2		117.4		

a Sample was inadvertently destroyed before this test could be determined.

TABLE VIII
SUMMARY OF TEST RESULTS FOR MACHINE F
July, 1959

Code	Date Made	Date Recd.	Mill Roll No.	Basis Weight, lb. per 1000 sq. ft.	Caliper, points		Concora Flat Crush, p.s.i. (Conditioned)			Concora Flat Crush, p.s.i. (Tested Immediately)			Single-Face Flat Crush, p.s.i.		Runability Maximum Tension at 600 f.p.m., lb./in.		
					Max.	Min.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.		Av.	
F-1	6-17-59	6-29-59	324	27.8	10.7	9.9	10.2	43.2	37.8	40.1	43.6	46.8	47.9	38.8	37.0	37.8	1-1/2
F-2	6-19-59	6-29-59	325	27.6	10.8	10.0	10.2	45.0	42.0	43.4	54.0	49.8	52.4	40.0	37.6	38.6	1
F-3	6-25-59	7-7-59	326	27.3	10.8	9.6	10.0	39.6	37.8	38.9	51.0	40.8	47.4	34.4	33.4	34.0	1-1/2
F-4	6-30-59	7-13-59	327	26.8	10.0	9.3	9.7	43.2	36.6	40.1	53.4	46.8	49.6	38.4	36.0	37.1	1-1/2
F-5	7-2-59	7-15-59	328	27.9	10.7	9.9	10.2	48.6	40.8	44.5	60.0	53.4	55.3	42.6	38.2	39.8	1-1/2
F-6	7-3-59	7-20-59	329	27.5	11.0	10.2	10.6	40.2	34.8	37.8	51.6	42.0	46.7	37.6	35.4	36.6	1-1/2
F-7	7-9-59	7-21-59	330	28.0	11.1	10.2	10.7	42.0	37.2	40.6	50.4	46.8	48.8	40.2	38.2	38.8	1-1/2
Current Machine Average				27.6	10.2					40.8			49.7			37.5	
Cumulative Machine Average				27.6	10.4					40.1			52.4			35.9	
Machine Factor, %				100.0	98.5					101.6			94.9			104.6	
Machine Index, %				101.5	100.4					112.0			106.1			114.6	

TABLE IX
SUMMARY OF TEST RESULTS FOR MACHINE G
July, 1959

Code	Date Made	Date Recd.	Mill Roll No.	Basis Weight, lb. per 1000 sq. ft.	Caliper, points		Concora Flat Crush, p.s.i. (Conditioned)			Concora Flat Crush, p.s.i. (Tested Immediately)			Single-Face Flat Crush, p.s.i.		Runability Maximum Tension at 600 f.p.m., lb./in.		
					Max.	Min.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.		Av.	
G-1	--	7-7-59	74	27.1	10.9	10.4	10.7	39.0	31.8	35.3	48.0	42.6	44.4	33.6	31.6	32.4	1-1/2
G-2	--	7-7-59	75	27.5	10.8	10.2	10.5	37.2	31.8	34.7	51.6	45.6	47.6	32.0	30.8	31.4	1-1/2
G-3	--	7-7-59	76	26.9	11.1	10.8	10.9	34.8	30.6	32.8	45.6	42.6	44.4	33.6	30.6	31.9	1-1/2
G-4	--	7-7-59	77	26.8	10.8	10.4	10.6	34.2	32.4	33.4	43.8	41.4	42.4	31.4	30.4	30.8	1-1/2
G-5	--	7-21-59	78	27.3	11.3	10.5	11.0	37.8	33.6	36.1	48.0	44.4	46.0	35.8	32.8	34.2	1
G-6	--	7-21-59	79	26.4	11.1	10.4	10.8	37.8	35.4	36.4	45.0	41.4	43.0	34.6	31.4	33.6	1-1/2
G-7	--	7-21-59	80	27.3	10.9	10.4	10.6	37.2	34.2	35.5	51.0	45.0	47.6	34.2	32.2	33.0	1-1/2
G-8	--	7-21-59	81	27.0	10.9	10.3	10.5	37.2	31.8	33.8	45.6	41.4	43.1	34.0	31.4	32.9	1-1/2
Current Machine Average				27.0	10.7				34.7		44.8				32.5		
Cumulative Machine Average				27.0	10.5				32.8		46.1				30.2		
Machine Factor, %				100.0	101.7				106.0		97.2				107.9		
Machine Index, %				99.5	105.1				95.4		95.5				99.3		

TABLE X
SUMMARY OF TEST RESULTS FOR MACHINE H
July, 1959

Code	Date Made	Date Recd.	Mill Roll No.	Basis Weight, lb. per 1000 sq. ft.	Caliper, points		Concora Flat Crush, p.s.i. (Conditioned)		Concora Flat Crush, p.s.i. (Tested Immediately)		Single-Face Flat Crush, p.s.i.		Runability Maximum Tension at 600 f.p.m., lb./in.		
					Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.			
H-1	6-16-59	7-13-59	182	27.2	10.5	9.8	10.2	43.2	39.0	40.3	51.6	46.2	48.8	38.3	1-1/2
H-2	6-18-59	7-13-59	183	27.0	10.2	9.8	10.1	43.2	39.6	41.2	55.2	45.6	51.5	39.4	1-1/2
H-3	6-19-59	7-13-59	184	28.0	10.2	10.0	10.1	39.0	34.8	36.6	55.2	46.2	48.8	36.2	1-1/2
H-4	7-1-59	7-15-59	185	26.9	10.3	8.4	9.8	42.0	38.4	40.6	54.6	45.6	50.0	36.4	1-1/2
H-5	7-2-59	7-15-59	186	26.2	10.1	9.8	9.9	42.0	35.4	38.5	51.0	45.6	48.4	36.0	1-1/2
H-6	7-7-59	7-15-59	187	26.4	10.2	9.7	9.9	41.4	35.4	37.7	57.0	48.6	51.5	36.6	1-1/2
H-7	7-8-59	7-15-59	188	26.9	10.2	9.7	9.9	43.2	36.6	38.8	54.0	47.4	51.0	37.6	1-1/2
Current Machine Average				26.9	10.0			39.1		50.0		36.8			
Cumulative Machine Average				26.8	10.2			36.0		45.3		32.6			
Machine Factor, %				100.5	97.9			108.5		110.4		112.9			
Machine Index, %				99.1	98.1			107.4		106.6		112.3			

TABLE XI
SUMMARY OF TEST RESULTS FOR MACHINE I
July, 1959

Code	Date Made	Date Recd.	Mill Roll No.	Basis Weight, lb. per 1000 sq. ft.	Caliper, points		Concora Flat Crush, p.s.i. (Conditioned)		Concora Flat Crush, p.s.i. (Tested Immediately)		Single-Face Flat Crush, p.s.i.		Runability Maximum Tension at 600 f.p.m., lb./in.
					Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	
I-1	7-2-59	7-13-59	161	26.6	10.9	10.2	32.4	28.8	30.7	47.4	40.2	43.7	1
I-2	7-2-59	7-13-59	162	26.6	10.7	10.0	34.2	31.8	32.6	45.0	39.6	42.0	1/2
Current Machine Average													
Cumulative Machine Average				26.6	10.4		31.7		42.8		29.9		
Machine Factor, %				27.3	10.4		32.8		44.1		29.6		
Machine Index, %				97.3	100.0		96.6		97.2		101.3		
				98.0	102.2		87.0		91.4		91.4		

TABLE XII
SUMMARY OF TEST RESULTS FOR MACHINE J
July, 1959

Code	Date Made	Date Recd.	Mill Roll No.	Basis Weight, lb. per 1000 sq. ft.	Caliper, points		Concora Flat Crush, p.s.i. (Conditioned)		Concora Flat Crush, p.s.i. (Tested Immediately)		Single-Face Flat Crush, p.s.i.		Runability Maximum Tension at 600 f.p.m., lb./in.
					Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	
J-1	6-3-59	7-1-59	244	27.3	10.0	9.4	40.8	36.0	39.0	50.4	45.0	48.1	1
J-2	6-5-59	7-1-59	410	26.5	9.8	9.1	37.2	33.6	35.3	46.2	40.2	43.7	1-1/2
J-3	6-8-59	7-13-59	609	26.9	9.4	9.1	37.8	34.8	36.4	51.0	43.8	46.7	1-1/2
J-4	6-10-59	7-13-59	740	26.2	9.3	9.1	39.6	34.2	36.8	46.8	42.6	44.9	1-1/2
J-5	6-25-59	7-24-59	1877	26.9	9.9	9.3	37.2	33.0	35.9	48.0	41.4	44.8	1-1/2
J-6	6-28-59	7-24-59	2092	26.7	9.9	9.4	38.4	34.2	36.8	46.8	42.6	45.5	1-1/2
Current Machine Average													
Cumulative Machine Average				26.7	9.5		36.7		45.6		34.2		
Machine Factor, %				26.6	9.8		35.2		45.6		32.2		
Machine Index, %				100.6	96.5		104.1		100.0		106.1		
				98.5	92.9		100.8		97.2		104.5		

TABLE XIII
SUMMARY OF TEST RESULTS FOR MACHINE K
July, 1959

Code	Date Made	Date Recd.	Roll No.	Basis Weight, lb. per 1000 sq. ft.	Caliper, points		Concora Flat Crush, p.s.i. (Conditioned)				Concora Flat Crush, p.s.i. (Tested Immediately)				Single-Face Flat Crush, p.s.i.		Runability Maximum Tension at 600 f.p.m., lb./in.
					Max.	Min.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.		
K-1	6-3-59	7-1-59	184	26.6	10.3	9.7	9.9	37.2	31.8	34.1	45.6	39.0	41.8	32.8	30.0	31.1	1/2
K-2	6-9-59	7-1-59	675	27.4	9.7	9.3	9.6	41.4	37.8	39.5	51.0	42.0	47.5	37.0	34.6	35.8	1-1/2
K-3	6-13-59	7-13-59	1014	26.7	9.8	9.3	9.7	37.8	34.2	36.5	44.4	36.0	41.6	38.4	35.6	36.6	1-1/2
K-4	6-18-59	7-13-59	1260	26.1	9.9	9.0	9.4	36.6	31.8	34.7	48.0	42.0	45.0	39.2	32.4	34.6	1-1/2
K-5	6-22-59	7-24-59	1514	24.9	9.3	9.0	9.1	37.2	33.0	35.3	43.8	39.0	41.3	33.2	31.0	32.3	1-1/2
K-6	6-29-59	7-24-59	2126	26.5	9.8	9.1	9.5	41.4	37.8	39.7	52.2	45.0	48.1	37.8	33.4	35.2	1-1/2
Current Machine Average				26.4			9.5			36.6			44.2			34.3	
Cumulative Machine Average				26.7			9.8			34.7			44.6			31.9	
Machine Factor, %				98.7			97.2			105.7			99.3			107.4	
Machine Index, %				97.1			93.5			100.6			94.3			104.7	

TABLE XIV
SUMMARY OF TEST RESULTS FOR MACHINE L
July, 1959

Code	Date Made	Date Recd.	Mill Roll No.	Basis Weight, lb. per 1000 sq. ft.	Caliper, points		Concora Flat Crush, p.s.i. (Conditioned)		Concora Flat Crush, p.s.i. (Tested Immediately)		Single-Face Flat Crush, p.s.i.		Runability Maximum Tension at 600 f.p.m., lb./in.
					Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	
L-1	6-11-59	7-7-59	292	27.6	9.6	8.9	40.8	38.4	40.0	57.0	49.2	51.4	1-1/2
L-2	6-13-59	7-7-59	293	26.0	9.5	8.8	43.2	36.0	40.0	51.6	44.4	48.1	1-1/2
L-3	6-15-59	7-7-59	294	28.4	9.7	8.9	39.6	36.0	37.9	47.4	42.6	45.7	1-1/2
L-4	6-25-59	7-7-59	295	27.2	10.0	9.2	38.4	34.2	36.1	47.4	42.0	45.1	1-1/2
L-5	6-23-59	7-24-59	296	27.4	10.1	9.8	36.6	34.2	35.5	46.8	42.6	44.3	1-1/2
L-6	7-1-59	7-24-59	297	25.2	9.9	9.3	39.6	36.0	37.9	52.2	48.0	50.5	1-1/2
L-7	7-9-59	7-24-59	298	24.9	8.7	8.1	36.0	34.2	34.9	48.0	43.8	46.3	1-1/2
L-8	7-9-59	7-24-59	299	27.8	10.0	9.3	42.0	36.0	40.1	48.0	44.4	46.8	1-1/2
Current Machine Average				26.8					37.8			47.3	34.7
Cumulative Machine Average				27.1					37.9			48.0	33.6
Machine Factor, %				98.9					99.7			98.5	103.5
Machine Index, %				98.7					103.8			100.8	106.1

TABLE XV
SUMMARY OF TEST RESULTS FOR MACHINE M
July, 1959

Code	Date Made	Date Recd.	Mill Roll No.	Basis Weight, lb. per 1000 sq. ft.	Caliper, points		Concora Flat Crush, p.s.i. (Conditioned)			Concora Flat Crush, p.s.i. (Tested Immediately)			Single-Face Flat Crush, p.s.i.		Runability Maximum Tension at 500 f.p.m., lb./in.
					Max.	Min.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	
N-1	5-23-59	6-29-59	13	25.8	10.8	10.3	35.4	30.6	32.8	40.2	35.4	37.8	31.6	29.4	30.9
N-2	5-25-59	6-29-59	14	26.6	11.3	10.7	35.4	31.8	33.7	42.6	37.2	39.2	31.4	28.6	30.2
N-3	5-28-59	6-29-59	15	26.6	12.1	10.7	42.0	34.8	38.2	47.4	39.0	43.4	35.4	33.6	34.4
N-4	6-1-59	6-29-59	16	25.7	10.6	10.2	38.4	33.6	35.8	45.0	37.8	41.3	34.0	32.6	33.2
N-5	6-4-59	6-29-59	17	26.4	11.0	10.4	42.0	33.0	36.5	45.0	39.6	41.5	34.0	31.8	32.6
N-6	6-8-59	6-29-59	18	26.8	10.7	10.4	39.6	31.8	35.2	48.0	36.0	43.3	33.2	30.4	31.6
N-7	6-11-59	6-29-59	19	28.2	10.6	10.2	37.2	33.6	35.2	46.2	40.8	43.2	34.6	32.4	33.6
N-8	6-22-59	6-29-59	20	26.5	11.1	10.6	39.6	34.2	35.9	50.4	43.2	45.7	35.6	30.8	33.7
Current Machine Average				26.6	10.7		35.4			41.9			32.5		32.5
Cumulative Machine Average				26.5	10.5		36.6			43.6			32.8		32.8
Machine Factor, %				100.3	101.4		96.7			96.2			99.3		99.3
Machine Index, %				97.8	104.5		97.2			89.4			99.4		99.4

TABLE XVI
SUMMARY OF TEST RESULTS FOR MACHINE N
July, 1959

N-1	6-24-59	7-9-59	706	27.1	11.0	10.3	46.8	42.6	44.4	57.6	53.4	55.0	41.2	36.8	39.0	Note a
Current Machine Average				27.1	10.7		44.4			55.0			39.0		39.0	
Cumulative Machine Average				27.0	10.6		39.0			52.5			35.2		35.2	
Machine Factor, %				100.4	101.0		113.6			104.7			110.6		110.6	
Machine Index, %				99.7	105.2		122.0			117.2			119.0		119.0	

a Maximum speed with minimum tension for this roll was 575 f.p.m.

TABLE XVII
SUMMARY OF TEST RESULTS FOR MACHINE O
July, 1959

Date	Date Recd.	Mill Roll No.	Basis Weight, lb. per 1000 sq. ft.	Caliper, points		Concora Flat Crush, p.s.i. (Conditioned)				Concora Flat Crush, p.s.i. (Tested Immediately)				Single-Face Flat Crush, p.s.i.		Runability Maximum Tension at 600 f.p.m., lb./in.
				Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	
0-1	6-18-59	251	29.0	11.2	10.3	10.8	37.2	34.2	36.0	52.2	44.4	48.0	32.8	31.2	32.0	1
0-2	6-20-59	252	29.0	10.9	10.2	10.6	40.8	35.4	38.3	48.0	42.6	45.6	33.6	30.0	32.5	1-1/2
0-3	6-27-59	253	28.1	10.8	10.0	10.4	37.2	33.0	34.6	48.0	37.8	42.6	30.8	29.6	30.2	1-1/2
0-4	7-2-59	254	29.5	11.2	10.3	10.7	42.0	34.2	38.3	49.8	42.0	45.4	35.6	32.8	34.3	1
0-5	6-23-59	255	28.7	10.9	9.8	10.5	36.6	32.4	34.3	45.0	39.0	41.4	32.0	29.4	30.9	1-1/2
0-6	7-8-59	256	29.3	10.7	10.0	10.4	42.0	37.2	39.5	52.8	46.8	49.6	38.6	35.4	37.0	1-1/2
0-7	7-13-59	257	29.2	10.9	10.2	10.7	40.8	35.4	39.0	49.2	45.0	47.6	37.8	34.6	36.3	1-1/2
Current Machine Average			29.0			10.6			37.1			45.7			33.3	
Cumulative Machine Average			28.4			10.6			35.6			43.9			31.6	
Machine Factor, %			101.9			100.0			104.2			104.1			105.3	
Machine Index, %			106.7			103.9			102.0			97.5			101.8	

DISCUSSION OF CONCORA FLAT CRUSH TEST RESULTS OBTAINED AT THE
INSTITUTE OF PAPER CHEMISTRY AND THOSE OBTAINED AT THE MILLS

In Table XVII a comparison of Institute and mill Concora flat crush test results is given for the month of July. These comparisons were initiated in Progress Report 30 and permit interested participants to submit their Concora flat crush test results to The Institute of Paper Chemistry so that comparative results may be included in the monthly reports. Data sheets for supplying this information may be obtained from the Institute. Comparisons of this kind are a helpful adjunct to other calibration procedures. It may be noted in Table XVII that fourteen of the fifteen participating machines are included in this comparison of Concora flat crush data. Shown in Table XVII are the Institute and mill Concora averages for each roll included in this comparison. In a few cases mill averages were not submitted for all rolls. In these instances, the current machine average based on Institute data included only those rolls for which mill data were received. The average difference between the current machine average based on Institute data and that based on mill data is shown in Table XVIII for each machine. For each roll the difference between the average Concora result based on Institute data and that based on mill data is also shown. The plus or minus sign denotes whether the mill average was higher or lower than the Institute average.

TABLE XVIII
COMPARISON OF INSTITUTE AND MILL CONCORDA FLAT CRUSH TEST RESULTS ON INDIVIDUAL ROLLS FOR JULY, 1959

Machine A				Machine B				Machine C			
Code	Roll No.	Date Made	Concorda Flat Crush, p.s.i. Difference	Code	Roll No.	Date Made	Concorda Flat Crush, p.s.i. Difference	Code	Roll No.	Date Made	Concorda Flat Crush, p.s.i. Difference
A-1	97	6-29-59	42.5	B-1	97	6-29-59	39.6	C-1	97	6-29-59	41.9
A-2	87	6-30-59	41.6	B-2	87	6-30-59	38.5	C-2	87	6-30-59	43.9
A-3	75	6-30-59	40.7	B-4	1307	7-7-59	34.6	C-3	75	6-30-59	42.0
A-4	1307	7-7-59	34.3	B-5	1307	7-9-59	35.3	C-4	34	7-14-59	39.5
A-5	1307	7-9-59	37.3	B-6	34	7-14-59	36.8	C-5	1	7-15-59	38.5
A-6	34	7-14-59	35.5	B-7	1	7-15-59	38.2	C-6	38	7-16-59	35.8
A-7	1	7-15-59	36.0	B-8	38	7-16-59	39.4				
A-8	38	7-16-59	38.9								
Current Machine Av.	38.4		34.9	Current Machine Av.	37.5		33.9	Current Machine Av.	40.3		37.7
Machine D				Machine E				Machine F			
D-1	159	6-24-59	38.3	E-1	481	6-24-59	41.3	F-1	321	6-17-59	40.1
D-2	160	6-24-59	35.3	E-2	482	6-26-59	42.6	F-2	325	6-19-59	43.4
D-3	165	7-16-59	35.5	E-3	483	7-1-59	41.4	F-3	326	6-25-59	38.9
D-4	166	7-16-59	38.4	E-4	484	7-7-59	41.6	F-4	327	6-30-59	40.1
				E-5	485	7-10-59	42.0	F-5	328	7-2-59	44.5
				E-6	486	7-15-59	43.1	F-6	329	7-8-59	37.8
				E-7	487	7-17-59	41.6	F-7	330	7-9-59	40.6
				E-8	488	7-20-59	43.2				
Current Machine Av.	36.9		35.7	Current Machine Av.	42.1		41.7	Current Machine Av.	40.8		39.5
Machine G				Machine H				Machine I			
G-1	74	--	35.3	H-1	182	6-16-59	40.3	I-1	161	7-2-59	30.7
G-2	75	--	34.7	H-2	183	6-18-59	41.2	I-2	162	7-2-59	32.6
G-3	76	--	32.8	H-3	184	6-19-59	38.6				
G-4	77	--	33.4	H-4	185	7-1-59	40.6				
G-5	78	--	36.1	H-5	186	7-2-59	38.5				
G-6	79	--	36.4	H-6	187	7-7-59	37.7				
G-7	80	--	35.5	H-7	188	7-8-59	38.8				
G-8	81	--	33.8								
Current Machine Av.	34.7		34.9	Current Machine Av.	39.1		37.5	Current Machine Av.	31.7		32.3

a The difference given here is the amount in p.s.i. units by which the mill result is higher or lower than the Institute result.

TABLE XVII-Continued
COMPARISON OF INSTITUTE AND MILL CONCORDIA FLAT CRUSH TEST RESULTS ON INDIVIDUAL ROLLS FOR JULY, 1959

Machine J					Machine K					Machine L				
Roll No.	Date Made	Concordia Insti- tute	Flat Crush, P.S.I. Differ- ence ^a	Mill	Roll No.	Date Made	Concordia Insti- tute	Flat Crush, P.S.I. Differ- ence ^a	Mill	Roll No.	Date Made	Concordia Insti- tute	Flat Crush, P.S.I. Differ- ence ^a	Mill
2-1	6-2-59	39.0	-1.2	37.8	K-1	6-3-59	34.1	37.0	37.0	L-1	6-11-59	40.0	40.8	40.8
2-2	6-5-59	35.3	-0.1	35.2	K-2	6-9-59	39.5	36.9	36.9	L-2	6-13-59	40.0	34.1	34.1
2-3	6-8-59	36.4	-0.6	35.8	K-3	6-13-59	36.5	33.7	33.7	L-3	6-15-59	37.9	34.5	34.5
2-4	6-10-59	36.8	-0.4	36.4	K-4	6-18-59	34.7	35.1	35.1	L-4	6-25-59	36.1	37.0	37.0
2-5	6-23-59	35.9	+1.6	37.5	K-5	6-22-59	35.3	34.7	34.7	L-5	6-28-59	35.5	35.8	35.8
2-6	6-23-59	36.6	-1.7	35.1	K-6	6-29-59	39.7	37.0	37.0	L-6	7-1-59	37.9	36.0	36.0
2-7										L-7	7-9-59	34.9	35.6	35.6
2-8										L-8	7-9-59	40.1	36.6	36.6
Current Machine Av.		36.7	-0.4	36.3	Current Machine Av.		36.6	35.7	35.7	Current Machine Av.		37.8	36.3	36.3

Machine M					Machine N				
Roll No.	Date Made	Concordia Insti- tute	Flat Crush, P.S.I. Differ- ence ^a	Mill	Roll No.	Date Made	Concordia Insti- tute	Flat Crush, P.S.I. Differ- ence ^a	Mill
1-1	5-23-59	32.8	+1.3	34.1	N-1	6-24-59	44.4	41.4	41.4
1-2	5-25-59	33.7	+2.4	36.1					
1-3	5-28-59	38.2	+0.1	38.3					
1-4	6-1-59	35.8	+3.7	39.5					
1-5	6-4-59	36.5	-2.4	34.1					
1-6	6-8-59	35.2	+4.3	39.5					
1-7	6-11-59	35.2	+3.9	39.1					
1-8	6-22-59	35.9	-1.7	34.2					
Current Machine Av.		35.4	+1.5	36.9	Current Machine Av.		44.4	41.4	41.4

^a The difference given here is the amount in p.s.i. units by which the mill result is higher or lower than the Institute result.

The data shown in Table XVIII are summarized in Part I of Table XIX where for each machine the following information is given: (1) Current machine average based on Institute data, (2) current machine average based on mill data, (3) the average difference--that is, the difference between the current machine average based on Institute data and that based on mill data and (4) the maximum difference encountered in comparing Institute and mill test averages for individual rolls. In Part II of Table XIX the average difference of Part I has been converted to per cent by dividing it by the Institute average and multiplying the result by 100. The average differences in per cent for the current report and the two preceding reports are shown. It may be seen that the highest average difference of 9.6% was associated with Machine B for the current period and the lowest of 0.6% with Machine G. Differences greater than five per cent were noted for Machines A, B, C, and N. In the majority of comparisons, agreement between Institute and mill data was good.

TABLE XIX
PART I: A COMPARATIVE SUMMARY FOR EACH MACHINE OF THE CONCORDA FLAT CRUSH AVERAGES BASED ON I.P.C.

DATA AND THOSE BASED ON MILL DATA

Machine Code	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
No. of Rolls Compared	8	7	6	4	3	7	8	7	2	6	6	8	8	1	0
Concorda Flat Crush, p.s.i.															
Current Machine Av.(I.P.C.) ^a	38.4	37.5	40.3	36.9	42.1	40.8	34.7	39.1	31.7	36.7	36.6	37.8	35.4	44.4	--
Current Machine Av.(Mill) ^a	34.9	33.9	37.7	35.7	41.7	39.5	34.9	37.5	32.3	36.3	35.7	36.3	36.9	41.4	--
Average Difference ^b	-3.5	-3.6	-2.6	-1.2	-0.4	-1.3	+0.2	-1.6	+0.6	-0.4	-0.9	-1.5	+1.5	-3.0	--
Maximum Difference ^c	-7.3	-5.8	-6.3	-2.2	-3.2	-4.3	-3.1	-3.7	+1.6	-1.7	+2.9	-5.9	+4.3	-3.0	--

PART II: A TABULATION FOR EACH MACHINE OF THE AVERAGE DIFFERENCE (PER CENT) BETWEEN THE CONCORDA

FLAT CRUSH AVERAGE BASED ON INSTITUTE DATA AND THAT BASED ON MILL DATA

Average Difference, % ^d															
Current Report	-9.1	-9.6	-6.5	-3.3	-1.0	-3.2	+0.6	-4.1	+1.9	-1.1	-2.5	-4.0	+4.2	-6.8	--
45th Report	-2.8	-6.5	-5.0	+1.7	-1.0	-6.4	-2.5	+5.1	+2.6	+1.1	-1.9	-1.8	-3.8	-9.6	--
44th Report	+12.6 ^e	+7.8 ^e	+13.6 ^e	+4.2	-1.7	-1.5	+4.0	+6.1	-0.3	-3.3	+0.6	+2.9	+3.6	-13.6	--

^a Comparisons based on current machine average include only those rolls for which mill data were submitted.

^b Average difference is the difference between the current machine average based on I.P.C. test results and that based on mill test results with the I.P.C. test results used as the reference. See Table XVII.

^c Maximum difference is the greatest difference encountered in comparing I.P.C. and mill test averages for individual rolls. See Table XVII.

^d Average difference (per cent) is computed by dividing the average difference in p.s.i. (shown above in Part I of this table) by the I.P.C. current machine average and multiplying the result by 100 to obtain the average difference in per cent.

^e Some of the Concorda specimens evaluated by this mill were not conditioned after being fluted.

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